

REMARKS

Prior to entry of the instant amendment, claims 1-14 and 16-19 are pending in the subject application. By the instant amendment, claims 44-50 are added. Claims 1 and 18 are independent.

Claims 1-14, 16-19 and 44-50 are presented to the Examiner for further or initial prosecution on the merits.

A. Introduction

In the outstanding Office Action Made Final, the Examiner rejected claims 18 and 19 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,316,357 to Lin et al. ("the '357 Lin et al. reference") and U.S. Patent No. 5,970,370 to Besser et al. ("the Besser et al. reference"), in combination with either U.S. Patent No. 5,010,037 to Lin et al. ("the '037 Lin et al. reference") or U.S. Patent Publication No. 2002/0006722 to Thakur ("the Thakur reference"); rejected claim 18 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference; rejected claim 19 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference, and further in view of the '357 Lin et al. reference; rejected claims 1-12 and 16 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference; rejected claim 5 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference, and further in view of U.S. Patent No. 5,909,059 to Hada et al. ("the Hada et al. reference"); rejected claim 17 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference, and further in view of U.S. Patent No. 6,087,250 to Hyakutake ("the Hyakutake reference"); and rejected claims 13 and 14 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al.

reference in combination with either the '037 Lin et al. reference or the Thakur reference, and further in view of U.S. Patent No. 6,133,109 to Nam ("the Nam reference") and U.S. Patent No. 6,168,992 to Lee ("the Lee reference").

B. Asserted Obviousness Rejection of Claims 18 and 19

In the outstanding Office Action Made Final, the Examiner rejected claims 18 and 19 under 35 U.S.C. § 103(a) as being unpatentable over the '357 Lin et al. reference and the Besser et al. reference, in combination with either the '037 Lin et al. reference or the Thakur reference. Applicants respectfully traverse this rejection, and respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness for at least the reasons set forth below.

1. The '357 Lin et al. and Besser et al. references fail to disclose or suggest a silicon-containing capping layer directly on a metal silicide layer

Claim 18 recites, *inter alia*,

a silicon-containing substrate;
....
a metal silicide layer directly on the silicon-containing substrate . . .; and
a silicon-containing capping layer directly on the metal silicide layer. . .

In the outstanding Office Action Made Final, the Examiner relied on the '357 Lin et al. and Besser et al. references as teaching the silicon-containing substrate, the metal silicide layer and the capping layer. In particular, the Examiner asserted,

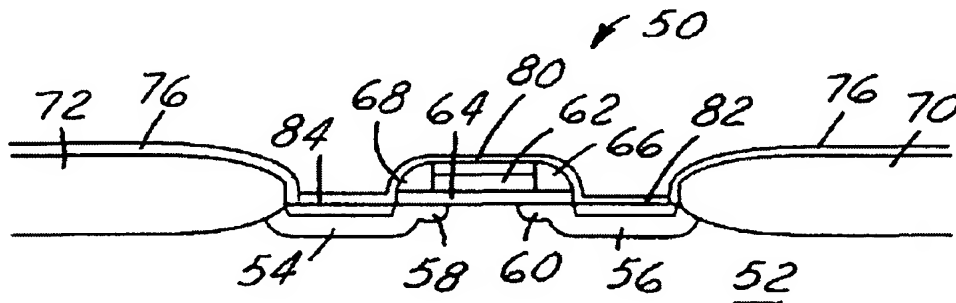
Lin et al. 6,316,357 B1 teach semiconductor device having a metal silicide contact structure comprising silicon substrate 52, gate oxide 64 thereon, gate stack 62 including polysilicon thereon, a metal silicide layer 76/80/82/84 formed on the directly on the gate and substrate. . .

....
Besser et al. 5,970,370 teach the use of a capping layer e.g., 403, Fig. 3A, on metal 402 . . .

(Office Action Made Final mailed March 29, 2007, pages 2-3).

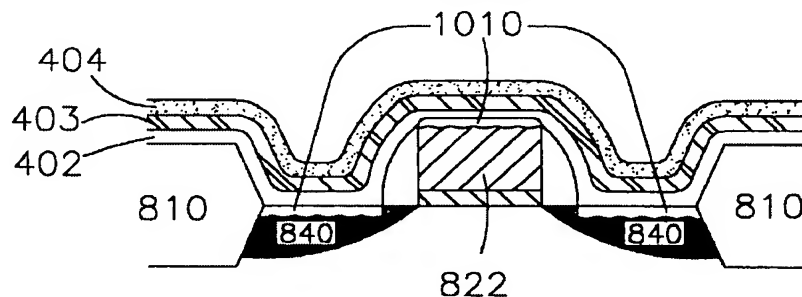
Applicants respectfully disagree with the Examiner's assertion. In particular, the '357 Lin et al. reference teaches that a *metal* layer 76¹, rather than a silicon-containing capping layer as recited in claim 18, is directly on the metal silicide layer 82. This is clearly shown in FIG. 2D of the Lin et al. reference, below. Thus, the '357 Lin et al. reference fails to disclose or suggest a silicon-containing capping layer *directly on* a metal silicide layer.

The '357 Lin et al. Reference, FIG. 2D



Moreover, the Examiner admits that the Besser et al. reference teaches a "capping layer" 403 *on the metal* 402. As is clearly shown in FIG. 10 of the Besser et al. reference, below, the metal layer 402 intervenes between the capping layer 403 and a silicide layer 1010, such that the capping layer 403 is not "directly on" the silicide layer 1010. Thus, the Besser et al. reference also fails to disclose or suggest a silicon-containing capping layer *directly on* a metal silicide layer.

The Besser et al. Reference, FIG. 10



¹ Feature 76 is a metal layer, not a metal silicide layer. See, e.g., the '357 Lin et al. reference, col. 5, lines 42-45. The metal layer 76 directly overlies each the silicides 80/82/84.

2. The '357 Lin et al. and Besser et al. references teach away from a silicon-containing capping layer directly on a metal silicide layer

Furthermore, applicants note that the '357 Lin et al. and Besser et al. references *require* a metal layer to directly overlie the silicide layer, and therefore teach away from the structure recited in claim 18. In particular, both the '357 Lin et al. reference and the Besser et al. reference teach that metal silicide layers are formed by reacting a metal layer with an underlying silicon-containing region.² Thus, these references teach away from a structure having a silicon-containing capping layer directly on the metal silicide layer, as recited in claim 18.

3. The '357 Lin et al. and Besser et al. references cannot be combined with either the '037 Lin et al. reference or the Thakur reference

Moreover, it would be unworkable to combine the '357 Lin et al. and Besser et al. references with the '037 Lin et al. and/or the Thakur references, because the '357 Lin et al. and Besser et al. references selectively form a silicide in a predetermined location, e.g., gate stack or source/drain, through a reaction that takes place only in that location.³ In this regard, it is notable that both the '357 Lin et al. and Besser et al. references rely on the use of a selective etch that *does not remove* metal silicide.⁴ In contrast, the '037 Lin et al. and Thakur references teach a blanket formation of a metal silicide across an entire surface of the substrate.⁵ However, if the metal silicide were formed as a blanket across the substrates of

² See the '357 Lin et al. reference at col. 1, lines 55-56, and col. 2, lines 22-28. See the Besser et al. reference at col. 6, line 63 to col. 7, line 2.

³ See the '357 Lin et al. reference at FIGS. 2C-2E and col. 5, line 54 to col. 6, line 33, which describe blanket deposition of a metal across the substrate, localized formation of metal silicides on the gate and source/drain regions, and then general wet etch of the substrate to remove unreacted metal, selectively leaving the metal silicides on the gate and source/drain regions. See the Besser et al. reference at FIGS. 8-11 and col. 6, line 44 to col. 7, line 19.

⁴ See the '357 Lin et al. reference at FIGS. 2D-2E and col. 6, lines 31-33. See the Besser et al. reference at FIGS. 10-11 and col. 7, lines 13-19.

⁵ See the '037 Lin et al. reference at col. 4, lines 5-15, which teaches blanket deposition of Co and Si via electron-gun evaporation. See the Thakur reference at paragraph [0015], which teaches blanket deposition from silane gas and tungsten hexafluoride.

the '357 Lin et al. and Besser et al. references, the etches used therein would not remove the metal silicide, rendering the respective processes unworkable.

In view of the above, applicants respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness with respect to claim 18. Therefore, claim 18, as well as claim 19 depending therefrom, are allowable over the proposed combination of references, and applicants respectfully request that this rejection be reconsidered and withdrawn.

C. Asserted Obviousness Rejection of Claim 18

In the outstanding Office Action Made Final, the Examiner rejected claim 18 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in view of the '037 Lin et al. reference or the Thakur reference. Applicants respectfully traverse this rejection, and respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness for at least the reasons set forth below.

In the outstanding Office Action Made Final, the Examiner asserted that the Besser et al. reference teaches, *inter alia*, a capping layer 403. However, as discussed above in Section B, the capping layer 403 is not “directly on” a metal silicide layer, and thus the Besser et al. reference fails to meet the limitations of claim 18. Moreover, the Besser et al. reference teaches away from a *silicon-containing* capping layer directly on the metal silicide layer, because the Besser et al. reference *requires* a metal layer to be directly on the metal silicide layer. Further, the Besser et al. reference cannot be combined with either the '037 Lin et al. reference or the Thakur reference.

In view of the above, applicants respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness with respect to claim 18. Therefore, claim 18 is allowable over the proposed combination of references, and applicants respectfully request that this rejection be reconsidered and withdrawn.

D. Asserted Obviousness Rejection of Claim 19

In the outstanding Office Action Made Final, the Examiner rejected claim 19 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in combination with either the '037 Lin et al. reference or the Thakur reference, and further in view of the '357 Lin et al. reference. Applicants respectfully traverse this rejection. Claim 19 depends from claim 18, and claim 18 is patentable over the proposed combination of references for the reasons set forth above in Section B. Accordingly, applicants respectfully request that this rejection be reconsidered and withdrawn.

E. Asserted Obviousness Rejection of Claims 1-12 and 16

In the outstanding Office Action Made Final, the Examiner rejected claims 1-12 and 16 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in view of the '037 Lin et al. reference or the Thakur reference. Applicants respectfully traverse this rejection, and respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness for at least the reasons set forth below.

Claim 1 recites, *inter alia*,

a silicon-containing substrate;
....
a metal silicide layer . . . directly on the silicon-containing
substrate . . .; and
a silicon-containing conductive layer directly on the metal
silicide layer. . .

In the rejection of claims 1-12 and 16, the Examiner relied on the Besser et al. reference as applied to claim 18. However, as discussed above in Section B, the capping layer 403 of the Besser et al. reference is not “directly on” a metal silicide layer. Thus, the Besser et al. reference fails to meet the limitations of claim 1. Moreover, the Besser et al. reference teaches away from a *silicon-containing* capping layer directly on the metal silicide layer, because the Besser et al. reference *requires* a metal layer to be directly on the metal

silicide layer. Further, the Besser et al. reference cannot be combined with either the '037 Lin et al. reference or the Thakur reference.

In view of the above, applicants respectfully submit that the Examiner failed to set forth a *prima facie* case of obviousness with respect to claim 1. Therefore, claim 1, as well as claims 2-12 and 16 depending therefrom, are allowable over the proposed combination of references, and applicants respectfully request that this rejection be reconsidered and withdrawn.

F. Asserted Obviousness Rejections of Claim 5

In the outstanding Office Action Made Final, the Examiner rejected claim 5 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in view of the '037 Lin et al reference or the Thakur reference and further in view of the Hada et al. reference. Applicants respectfully traverse this rejection for at least the reasons set forth below.

Claim 5 depends from claim 1, which is allowable over the proposed combination of the Besser et al., '037 Lin et al. and Thakur references for the reasons set forth above in Section E. Moreover, the Hada et al. reference is directed to a method that forms a tungsten silicide film across an entire surface of a substrate, and thus cannot be combined with the teachings of the Besser et al. reference for reasons similar to those set forth above regarding the '037 Lin et al. and Thakur references. Accordingly, applicants respectfully submit that claim 5 is allowable over the proposed combination of references, and respectfully request that this rejection be reconsidered and withdrawn.

G. Asserted Obviousness Rejections of Claim 17

In the outstanding Office Action Made Final, the Examiner rejected claim 17 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in view of the '037 Lin et al. reference or the Thakur reference and further in view of the Hyakutake reference. Applicants respectfully traverse this rejection for at least the reasons set forth below.

Claim 17 depends from claim 1, which is allowable over the proposed combination of the Besser et al., '037 Lin et al. and Thakur references for the reasons set forth above in Section E. Moreover, the Hyakutake reference fails to so much as mention a silicide and thus, even if it could be combined with the Besser et al. reference, would nevertheless fail to cure the deficiencies of the Besser et al. reference. Accordingly, applicants respectfully submit that claim 17 is allowable over the proposed combination of references, and respectfully request that this rejection be reconsidered and withdrawn.

H. Asserted Obviousness Rejections of Claims 13 and 14

In the outstanding Office Action Made Final, the Examiner rejected claims 13 and 14 under 35 U.S.C. § 103(a) as being unpatentable over the Besser et al. reference in view of the '037 Lin et al. reference or the Thakur reference and further in view of the Nam reference and the Lee reference. Applicants respectfully traverse this rejection for at least the reasons set forth below.

Claims 13 and 14 depend from claim 1, which is allowable over the proposed combination of the Besser et al., '037 Lin et al. and Thakur references for the reasons set forth above in Section E. Moreover, the Nam and Lee references both fail to so much as mention a silicide. Thus, even if the Nam and Lee references could be combined with the Besser et al. reference, they would fail to cure the deficiencies of the Besser et al. reference. Accordingly, applicants respectfully submit that claims 13 and 14 are allowable over the proposed combination of references, and respectfully request that this rejection be reconsidered and withdrawn.

I. New Claims

By the instant amendment, dependent claims 44-50 are added. Claims 44-46 depend from claim 1 and claims 47-50 depend from claim 18. Claims 44-50 recite subject matter that is not disclosed or suggested by the cited prior art references, and are allowable for at least the reasons that their respective base claims are allowable.

J. Entry of Amendment Requested

Applicants respectfully submit that the pending claims are in condition for allowance, and that the instant amendment overcomes the rejections set forth in the outstanding Office Action Made Final. Accordingly, entry and consideration of the instant amendment does not place an undue burden on the Examiner, and entry of the instant amendment is respectfully requested.

K. Conclusion

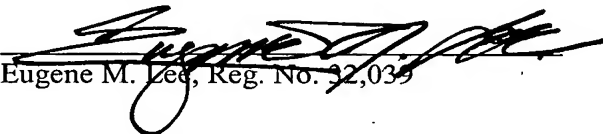
If the Examiner believes that additional discussions or information might advance the prosecution of the instant application, the Examiner is invited to contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.

In view of the foregoing amendments and remarks, reconsideration of this application is earnestly solicited, and an early and favorable further action upon all the claims is hereby requested.

Respectfully submitted,

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PETITION and
DEPOSIT ACCOUNT CHARGE AUTHORIZATION

This document and any concurrently filed papers are believed to be timely. Should any extension of the term be required, applicant hereby petitions the Director for such extension and requests that any applicable petition fee be charged to Deposit Account No. 50-1645.

If fee payment is enclosed, this amount is believed to be correct. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1645.

Any additional fee(s) necessary to effect the proper and timely filing of the accompanying-papers may also be charged to Deposit Account No. 50-1645.